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Drinking Water Surveillance Program

HAMILTON WATER SUPPLY SYSTEM

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HAMILTON
WATER SUPPLY SYSTEM

DRINKING WATER SURVEILLANCE PROGRAM

ANNUAL REPORT 1988

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EXECUTIVE SUMMARY

DRINKING WATER SURVEILLANCE PROGRAM

HAMILTON WATER SUPPLY SYSTEM
1988 ANNUAL REPORT

The Drinking Water Surveillance Program (DWSP) for Ontario is a monitoring program providing immediate, reliable, current information on drinking water quality. The DWSP officially began in April 1986 and is designed to eventually include all municipal supplies in Ontario. Currently, 52 plants are being monitored.

The Hamilton Water Treatment Plant is a conventional treatment plant which treats water from Lake Ontario. The process consists of coagulation, flocculation, sedimentation, filtration, disinfection and fluoridation. This plant has a design capacity of 909 x 1000 m^3/day and serves a population of approximately 412,000.

Water samples from the raw, treated and two distribution sites were taken on a monthly basis and analysed for approximately 160 parameters, during 1988. Parameters were divided into the following groups Bacteriological, Inorganic and Physical(Laboratory Chemistry, Field Chemistry and Metals) and Organics (Chloroaromatics, Chlorophenols, Pesticides and PCB, Phenolics, Polynuclear Aromatic Hydrocarbons, Specific Pesticides and Volatiles). Specific Pesticides and Chlorophenols were analysed for in June and November only.

A summary of results is shown in Table 1.

Inorganic and Physical parameters (Laboratory Chemistry, Field Chemistry and Metals) were below any applicable health related ODWOs.

Of approximately 110 Organic parameters tested for on a monthly basis, none exceeded health related guidelines.

During 1988 the DWSP sampling results indicated that the Hamilton Water Supply System produced good quality water at the plant and this quality was maintained in the distribution system.

TABLE 1

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON WSS

SUMMARY TABLE BY SCAN

	RAW			TREATED			SITE 1			SITE 2		
SCAN	TESTS	POSITIVE	%POSITIVE	TESTS	POSITIVE	%POSITIVE	TESTS	POSITIVE	%POSITIVE	TESTS	POSITIVE	%POSITIVE
BACTERIOLOGICAL	44	38	86	44	11	25	44	8	18	44	10	22
CHEMISTRY (FLD)	42	39	92	61	59	96	98	94	95	81	79	97
CHEMISTRY (LAB)	246	201	81	246	188	76	432	368	85	398	340	85
METALS	288	171	59	288	167	57	564	337	59	564	319	56
CHLOROAROMATICS	154	0	0	140	0	0	154	0	0	154	0	0
CHLOROPHENOLS	6	0	0	6	0	0	.	.	.	.	.	.
PAH	204	0	0	204	0	0	.	.	.	.	.	.
PESTICIDES & PCB	375	0	0	354	0	0	375	0	0	375	0	0
PHENOLICS	12	6	50	12	3	25	.	.	.	.	.	.
SPECIFIC PESTICIDES	28	0	0	28	0	0	0	0	0	0	0	0
VOLATILES	284	1	0	282	36	12	253	32	12	282	36	12
TOTAL	1683	456		1665	464		1920	839		1898	784	

NO HEALTH RELATED GUIDELINES WERE EXCEEDED

A POSITIVE VALUE DENOTES THAT THE RESULT IS GREATER THAN THE STATISTICAL LIMIT OF DETECTION AND IS QUANTIFIABLE
A '.' INDICATES THAT NO SAMPLE WAS TAKEN

DRINKING WATER SURVEILLANCE PROGRAM

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INTRODUCTION

The Drinking Water Surveillance Program (DWSP) for Ontario is a monitoring program providing immediate, reliable, current information on drinking water quality. The DWSP officially began in April 1986 and is designed to eventually include all municipal supplies in Ontario. Currently, 52 plants are being monitored. The DWSP program was initiated at the Hamilton Water Treatment Plant in the spring of 1986. Annual reports were published for 1986 (ISBN 0-7729-2554-2) and 1987 (ISSN 0839-9034).

This report contains information and results for 1988.

PLANT DESCRIPTION

The Hamilton Water Treatment Plant is a conventional treatment plant which treats water from Lake Ontario. The process consists of coagulation, flocculation, sedimentation, filtration, disinfection and fluoridation. Ammoniation is used to produce a long-lasting chloramine residual in the distribution system. Sulphur Dioxide is used as a dechlorinator when necessary.

This plant has a design capacity of 909 x 1000 m^3/day and flows on day of sampling ranging from 176 x 1000 m^3/day to 329 x 1000 m^3/day. The plant serves a population of 412,000.

The plant location is shown in Figure 1. Plant Process details, in a block schematic, are shown in Figure 2. General plant information is presented in Table 2.

METHODS

Water samples were obtained from four DWSP approved locations;

i) Plant Raw - The water originated from the surge well prior to chlorination and was sampled through a copper line. The sample tap is located in the plant laboratory.

ii) Plant Treated - The water originated from the highlift discharge after addition of all treatment chemicals and was sampled through a copper line. The sample tap is located in the plant laboratory.

iii) Distribution System - Site 1 - This house is approximately 1 kilometer from the plant. Water was sampled through copper plumbing from the basement laundry tap.

FIGURE 1

DRINKING WATER SURVEILLANCE PROGRAM

SITE LOCATION MAP

HAMILTON WATER TREATMENT PLANT

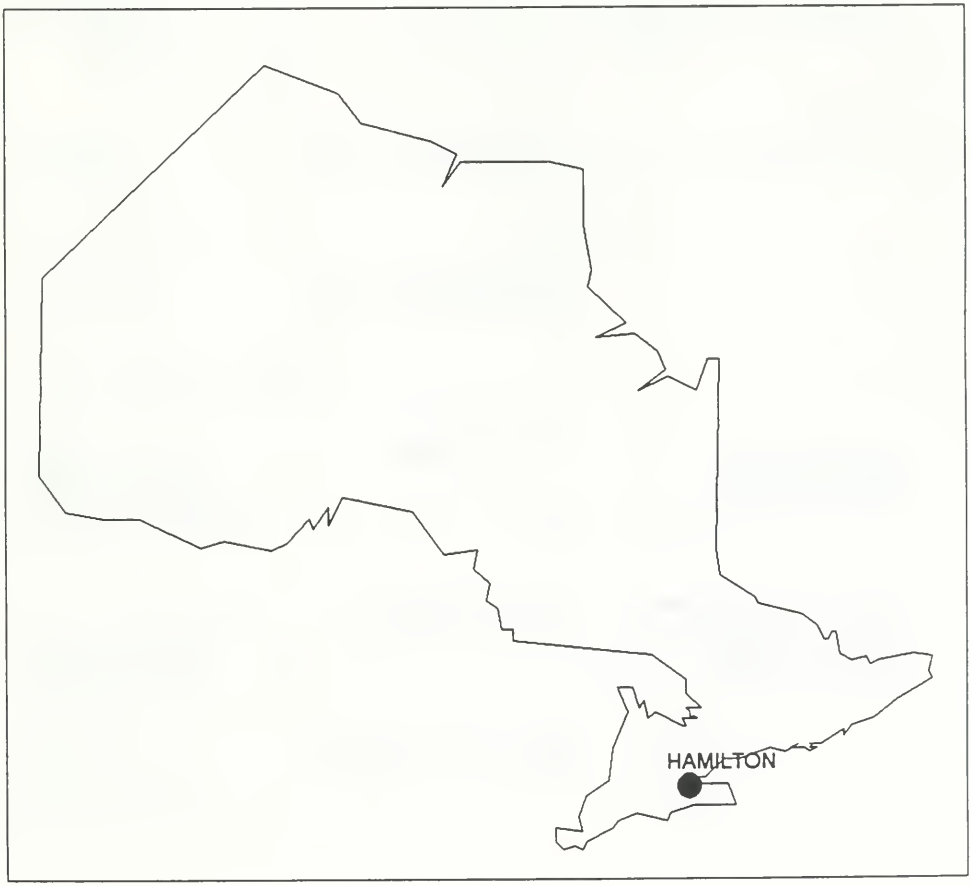

Figure 2

HAMILTON WATER TREATMENT PLANT

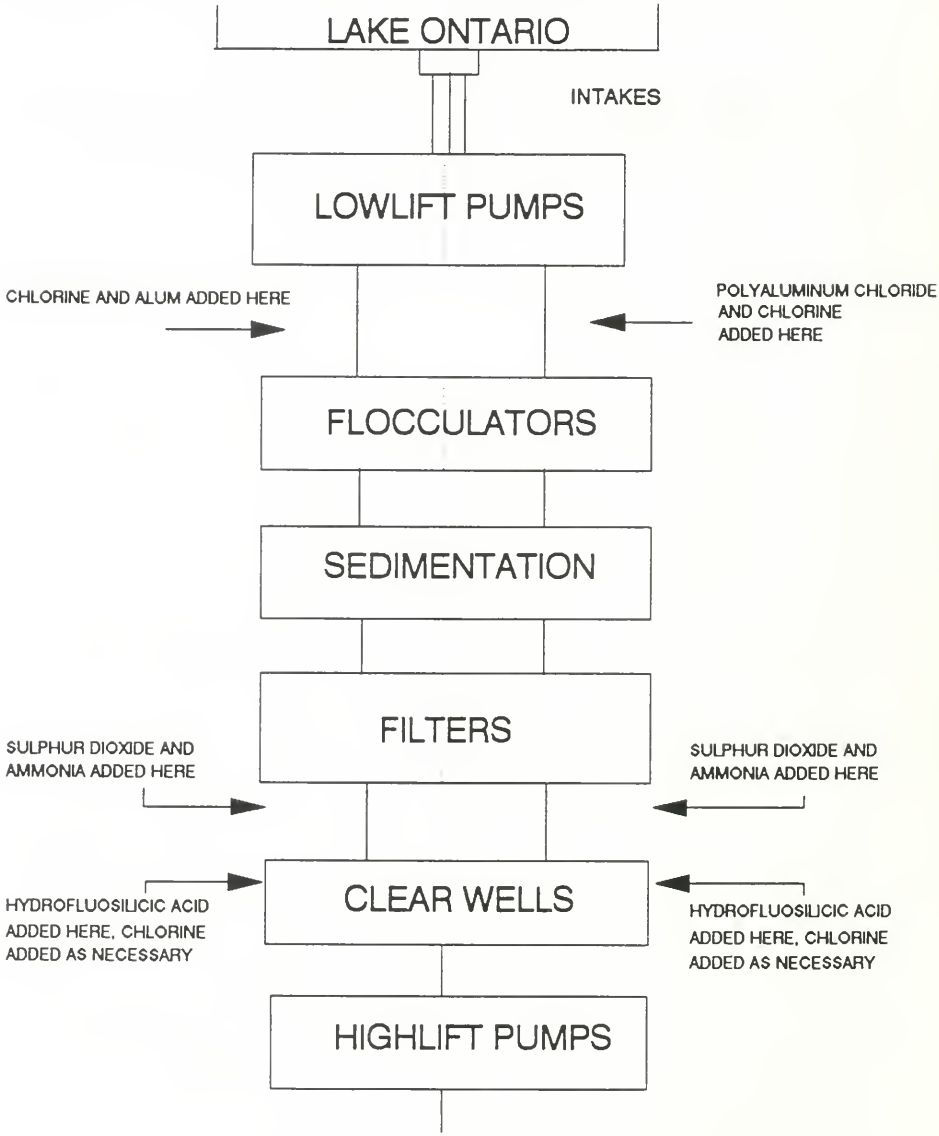

TABLE 2

DRINKING WATER SURVEILLANCE PROGRAM ANNUAL REPORT

GENERAL INFORMATION

HAMILTON WATER SUPPLY SYSTEM

LOCATION:	900 WOODWARD AVE HAMILTON, ONTARIO L8H 7N2 (416-526-4484)
SOURCE:	RAW WATER SOURCE - LAKE ONTARIO
RATED CAPACITY:	909 (1000 M^3/DAY)
OPERATION:	MUNICIPAL
PLANT SUPERINTENDENT:	W. FURRY
MINISTRY REGION:	WEST CENTRAL
DISTRICT OFFICER:	MR. J.W. VOGT

MUNICIPALITY SERVED	POPULATION
ANCASTER	16,542
DUNDAS TOWN	20,081
HAMILTON	307,690
STONEY CREEK	41,690
WATERDOWN	25,541

iv) Distribution System - Site 2 - This house is approximately 14 kilometers from the plant. Water was sampled through copper plumbing from the basement laundry tap.

Sample lines in the plant were flushed prior to sampling to ensure that the water obtained was indicative of its origin and not residual water standing in the sample line.

At both distribution system locations two types of samples were obtained: a standing and a free flow. The standing sample consisted of water that had been in the household plumbing and service connection for a minimum of six hours. These samples are used to make an assessment of the amount by which the levels of inorganic compounds and metals may be changed on standing due to leaching from (or deposition on) the plumbing system. The only analyses carried out on the standing samples therefore, are General Chemistry and Metals. The free flow sample represented fresh water from the distribution main that had been flowing at the sample tap for five minutes before being sampled.

Attempts were made to capture the same block of water at each sampling point by taking the retention time into consideration. The retention time was calculated by dividing the volume of water between the two sampling points by the sample day flow. For example, if it was determined that the retention time within the

plant was five hours then there would be a five hour interval between the raw and treated sampling. Similarly if it was estimated that it took approximately one day for the water to travel from the plant to the distribution system site, this site would be sampled one day after the treated water from the plant.

Stringent DWSP sampling protocols were followed to ensure that all samples were taken in a uniform manner.

Sample day flow, treatment chemical dosages and Field Chemistry measurements were recorded on the day of sampling and were entered on the DWSP database as submitted.

RESULTS

Water at the Hamilton Water Treatment Plant and two sites in the distribution system was sampled for approximately 160 parameters on a monthly basis. The Specific Pesticides and Chlorophenols scans were sampled in June and November only. Polynuclear Aromatic Hydrocarbons and Phenolics were only analysed in the raw and treated water at the plant. As a result of an unforeseen emergency the laboratory capacity was exceeded and analysis for volatiles could not be carried out when the samples were received. Since analysis for volatiles is no longer valid after four weeks of storage, volatile results for January or February are not available.

Table 3 contains information on the sample day retention time, flow rate and treatment chemicals used and their associated dosages.

Table 4 is a summary break-down of the number of water samples analysed by parameter and by water type. The number of times that a positive or trace result was detected is also reported. Positive denotes that the result is greater than the statistical limit of detection established by the Ministry of the Environment (MOE) laboratory staff and is quantifiable. Trace (<T) denotes that the level measured is greater than the lowest value detectable by the method but lies so close to the detection limit that it cannot be confidently quantified.

Table 5 presents the results for parameters detected on at least one occasion.

Table 6 lists all parameters analysed in the DWSP.

Associated guidelines and detection limits are also supplied on tables 5 and 6. Parameters are listed alphabetically within each scan.

DISCUSSION

General

Water quality is judged by comparison with the Ontario Drinking Water Objectives (ODWOs) as defined in the 1984 publication (ISBN 0-7743-8985-0). The Province of Ontario has health related and aesthetic objectives for 49 parameters. These are currently under review. When an ODWO is not available guidelines/limits from other agencies are consulted. The Parameter Listing System (PALIS) recently published (ISBN 0-7729-4461-X) by the MOE catalogues and keeps current over 1750 guidelines for 650 parameters from agencies throughout the world.

Although some of the parameters measured on DWSP may be present in the raw and treated water as a result of pollution, many of the compounds detected are naturally occurring or are treatment by-products.

Plant operational personnel address occurrences of taste and odour or biological water quality parameters. The DWSP does not assess these aspects of the water supply.

As stated under Results, traces do not indicate quantifiable values, as defined by established MOE Laboratory analytical reporting protocols. While they can be useful in trend analysis or confirmation of a specific contaminant that is repeatedly

detected at these levels, the occasional finding of a trace level of a contaminant is not considered to be significant. **DISCUSSION OF GUIDELINES AND LIMITS THEREFORE, IS ONLY CONDUCTED ON POSITIVE RESULTS.**

Bacteriology

Positive results for the Bacteriology scan were present eleven times in the treated water, eight times in the Site 1 water and ten times the Site 2 water. The positive parameters were Standard Plate Count and Total Coliform Background. The results show that bacteriological quality control was achieved at the plant and maintained in the distribution system.

Guidelines for bacteriological sampling and testing of a supply are developed to maintain a proper supervision of its bacteriological quality; the routine monitoring program usually requires the taking of multiple samples in a given system. Full interpretation of bacteriological quality cannot be made on the basis of single samples. Routine bacteriological monitoring, as outlined in the ODWOs is carried out by the operating authority.

Inorganic and Physical Parameters

Laboratory and Field Chemistry

The results for Laboratory and Field Chemistry scans were below any applicable health related ODWOs.

The Total Ammonium levels are high, not as a result of naturally occurring ammonia (eg. from sewage pollution) but from the ammonia added in the treatment process. The anhydrous ammonia is added prior to the post-chlorination to provide a long lasting combined chloramine residual in the distribution system. While the European Economic Community has an aesthetic guideline of .05 mg/L, the Maximum Admissable Concentration is .50 mg/L and is set as a result of the concern for potential sewage pollution and its detection.

It is desirable that the Temperature of drinking water be less than 15°C; the palatability of water is enhanced by its coolness. A temperature below 15°C will tend to reduce the growth of nuisance organisms and hence minimize associated taste, colour, odour and corrosion problems. The temperature of the delivered water may increase in the distribution system due to the warming effect of the soil in late summer and fall and/or as a result of higher temperatures in the source water. The desired ODWO was exceeded eight times in the treated water and free flow distributed water.

Colour values exceeded the aesthetic ODWO of 5 True Colour Units

(TCU) in the September treated water sample at 7.5 TCU and the Site 1 water sample at 5.5 TCU. Colour in drinking water may be due to the presence of natural or synthetic organic substances as well as certain metallic ions.

The ODWO indicate that a hardness level of between 80 and 100 mg/L as calcium carbonate for domestic waters, provides an acceptable balance between corrosion and incrustation. Water supplies with a hardness greater than 200 mg/L are considered poor, and would possess a tendency to form scale deposits and result in excessive soap consumption. The Hamilton water had hardness values ranging from 129 mg/L to 145 mg/L as $CaCO_3$.

The Langelier Index is used extensively in estimating the corrosion potential of water. An increasingly negative index indicates the increasing possibility of corrosion. It is considered sound engineering practice to maintain a slightly positive Langelier Index. The Langelier Index for Hamilton is consistently positive.

As part of the treatment plant process, hydrofluosilicic acid is added to the treated water (Table 3). Where fluoridation is practised, the fluoride concentration recommended in the ODWO is 1.2 mg/L, plus or minus 0.2 mg/L. Results indicate that the plant was rarely successful in maintaining this level as can be seen from the fluoride levels in Table 5. The plant reported that for two months, hydrofluosilicic acid was not available from the supplier.

The fluoride feed equipment was undergoing maintenance for one other month when hydrofluorosilcic acid was not reported to have been added.

Metals

The results reported for the Metal scan were below any applicable health related ODWOs.

Elevated levels of Copper, Lead and Zinc were detected in the standing samples from the distribution system as compared to the free flow samples thus, indicating that small quantities of these metals were leached from the household plumbing as the water stood overnight. Although the Langelier Index indicates minimal potential for corrosion some metals will be leached in standing samples in most supplies.

The ODWO for Chromium of 50 ug/L was exceeded in the February treated water sample at 470 ug/L and in the November treated water sample at 190 ug/L. Samples taken in the distribution system for the same time period did not show elevated levels of chromium. Sample contamination is the suspected cause for the elevated Chromium levels. The District Officer was notified.

At present, there is no evidence that Aluminum is physiologically harmful and no health limit for drinking water has been specified. The measure of residual Aluminum in the treated water is important

to indicate the efficiency of the treatment process. The ODWOs indicate that a useful guideline is to maintain a residual below 100 ug/L as Al in the water leaving the plant to avoid problems in the distribution system. Aluminum values exceeded the ODWO operational guideline four times in the treated water.

Organic Parameters

Chloroaromatics

Results of the Chloroaromatics scan showed that one parameter was detected:

Hexachloroethane

Hexachloroethane was detected at a trace level, once in the Site 2 water.

Review of these results, along with information from other water supplies on DWSP, would indicate that certain Chloroaromatics appear more frequently in the treated water than in the raw and almost always only at trace levels. These occurrences could possibly be due to a reaction of chlorine with organics present in the water or the distribution system.

Chlorophenols

Results of the Chlorophenol scan showed that no Chlorophenols were detected.

Pesticides and PCB (Polychlorinated Biphenyl)

Results of the Pesticide and PCB scan showed that no PCBs were detected and that three pesticides were detected:

Alpha BHC

Lindane

Atrazine

There are several isomers of BHC (Benzene Hexachloride); gamma BHC is the active ingredient of the pesticide Lindane, while alpha BHC is the isomer predominantly found in surface waters of the Great Lakes basin.

Alpha BHC was detected at trace levels, eight times in the raw water, eight times in the treated water, nine times in the Site 1 water and eight times in the Site 2 water.

Lindane was detected at trace levels, three times in the raw water, three times in the treated water, five times in the Site 1 water and four times in the Site 2 water.

Atrazine was detected at trace levels, twice in the raw water and once in the treated water.

Specific Pesticides

Results of the Specific Pesticide scan showed that no specific pesticides were detected.

Phenolics

The maximum desirable concentration of phenolic substances in drinking water is 2.0 ug/L. This limit has been set primarily to prevent the occurrence of undesirable tastes and odours, particularly in chlorinated water. Phenolics were detected in the raw water at quantifiable levels ranging from 1.0 to 2.0 ug/L and in the treated water ranging from 1.0 tp 1.6 ug/L. Phenolics were also detected at trace levels, four times in the raw water and seven times in the treated water. Phenolic compounds are present in the aquatic environment as a result of natural and/or industrial processes.

Polynuclear Aromatic Hydrocarbons (PAH)

Results of the PAH scan showed that one PAH was detected:

Benzo (E) Pyrene

Benzo (E) Pyrene was detected at a trace level, once in the raw water.

Volatiles

Results of the Volatile scan showed that seven parameters, other than Trihalomethanes(THMs), were detected:

Toluene

Ethylbenzene

Meta-Xylene

Ortho-Xylene

Styrene

Trans 1,2-Dichloroethylene

Tetrachloroethylene

Toluene was detected at trace levels, once in the raw water, twice in the treated water and four times in both the Site 1 water and Site 2 water. The detection of toluene at low, trace levels is a laboratory artifact derived from the analytical methodology. The purge-and-trap analytical technique depends on the purging of the volatile organics in the water sample with helium gas onto a Tenax trapping column. The volatile materials are subsequently thermally desorbed, separated and quantified. Tenax, a toluene-like polymeric material, tends to decompose sporadically upon heating into toluene and other aromatic componenets (ethylbenzene and xylene) giving instrument blanks in the order of 0.05 ug/L.

The detected trace levels of Styrene are also considered to be laboratory artifacts due to the outgassing of monomeric styrene from the polystyrene shipping containers. The sporadic background levels from this source are in the order of 0.05 ug/L.

Ethylbenzene was detected at trace levels, once in the raw water,

five times in the treated water, seven times in the Site 1 water and six times in the Site 2 water.

Meta-Xylene(M-Xylene) was detected at trace levels, once in the raw water and twice in the Site 1 water.

Ortho-Xylene (O-Xylene) was detected at trace levels, once in the raw water and once in the treated water.

The volatiles listed above are typically found on an occasional basis at other water supplies included on the DWSP usually at trace levels.

Trans(T) 1,2-Dichloroethylene was detected at a trace level, once in the treated water.

Tetrachloroethylene (T-Chloroethylene) was detected in the April treated water sample at 4.0 ug/L. The World Health Organization's (WHO) tentative guideline value for tetrachloroethylene in drinking water is 10.0 ug/L.

THMs are known to be produced during the water treatment process and will always occur in chlorinated surface waters. THMs are comprised of Chloroform, Chlorodibromomethane and Dichlorobromomethane. Bromoform occurs occasionally. Results are reported for the individual compounds as well as for total THMs.

Chloroform, Chlorodibromomethane, Dichlorobromomethane and Total THMs were detected in all treated waters. Bromoform was detected at trace levels in all but two Site 2 samples. All Total THM occurrences, ranging from 18.3 to 51.7 ug/L, were well below the ODWO of 350 ug/L.

CONCLUSIONS

The Hamilton Water Supply System for the sample year of 1988 produced good quality water at the plant and this quality was maintained in the distribution system.

Raw and treated water quality from 1986 to 1988 has remained consistent.

No health related guidelines, for organic or inorganic parameters, were exceeded during 1986, 1987 or 1988.

RECOMMENDATIONS

Three recommendations can be made:

1) The reason for elevated Aluminum levels in treated water samples should be investigated.

2) The fluoridation practice should be adjusted to ensure that the recommended fluoride levels are achieved in distributed water.

3) Consideration should be given to reducing sample frequency.

TABLE 3

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON WSS SAMPLE DAY CONDITIONS FOR 1988

SAMPLE DAY CONDITIONS			TREATMENT CHEMICAL DOSAGES (MG/L)					
			PRE-CHLORINATION	COAGULATION	COAGULATION		POST-CHLORINATION	FLUORIDATION
			CHLORINE	ALUM LIQUID	POLYALUMINUM CHLORIDE	POLYALUMINUM SULPHATE	CHLORINE	HYDROFLUOSILICIC ACID
DATE	RETENTION TIME(HRS)	FLOW (1000M3)						
JAN 26	6.0	207.5	1.40	3.00	.	.	.	.98
FEB 23	2.0	215.7	1.30	.	.50	.	.28	.98
MAR 29	2.5	242.1	1.80	3.00	.	.	.45	1.01
APR 27	5.6	175.6	1.70	4.00	.50	.	.48	1.05
MAY 25	4.0	215.8	2.50	4.30	.68	.	.33	1.03
JUN 29	3.5	329.5	3.00	3.40	.70	.	.35	.84
JUL 27	3.4	244.7	1.50	.	6.00	6.00	.24	.
AUG 23	3.5	255.0	2.80	4.50	.	.	.68	1.02
SEP 27	4.0	239.3	2.20	5.50	.	.	.41	.
OCT 26	4.0	251.0	1.80	4.00	1.00	.	.14	.
NOV 30	6.0	216.6	1.70	3.80	1.33	.	.33	1.14
DEC 19	4.5	213.5	1.90	3.60	.67	.	.24	1.19

ANHYDROUS AMMONIA WAS ADDED ON A CONTINUOUS BASIS AT .30 MG/L

TABLE 4

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON

SUMMARY TABLE OF RESULTS (1988)

SCAN	PARAMETER	RAW TOTAL	RAW POSITIVE	RAW TRACE	TREATED TOTAL	TREATED POSITIVE	TREATED TRACE	SITE 1 TOTAL	SITE 1 POSITIVE	SITE 1 TRACE	SITE 2 TOTAL	SITE 2 POSITIVE	SITE 2 TRACE
BACTERIOLOGICAL	FECAL COLIFORM MF	12	7	0	.	.	.	.	.	.	.	.	.
	STANDRD PLATE CNT MF	8	7	0	12	10	0	12	8	0	12	10	0
	P/A BOTTLE	.	.	.	8	0	0	8	0	0	8	0	0
	TOTAL COLIFORM MF	12	12	0	12	0	0	12	0	0	12	0	0
	T COLIFORM BCKGRD MF	12	12	0	12	1	0	12	0	0	12	0	0
*TOTAL SCAN BACTERIOLOGICAL		44	38	0	44	11	0	44	8	0	44	10	0
*TOTAL GROUP BACTERIOLOGICAL		44	38	0	44	11	0	44	8	0	44	10	0
CHEMISTRY (FLD)	FLD CHLORINE (COMB)	2	1	0	12	11	0	21	19	0	15	15	0
	FLD CHLORINE FREE	2	1	0	1	0	0	4	2	0	4	2	0
	FLD CHLORINE (TOTAL)	2	1	0	12	12	0	21	21	0	15	15	0
	FLD PH	12	12	0	12	12	0	20	20	0	23	23	0
	FLD TEMPERATURE	12	12	0	12	12	0	24	24	0	24	24	0
	FLD TURBIDITY	12	12	0	12	12	0	8	8	0	.	.	.
*TOTAL SCAN CHEMISTRY (FLD)		42	39	0	61	59	0	98	94	0	81	79	0
CHEMISTRY (LAB)	ALKALINITY	12	12	0	12	12	0	24	24	0	22	22	0
	CALCIUM	12	12	0	12	12	0	24	24	0	22	22	0
	CYANIDE	12	0	0	12	0	0	12	0	0	12	0	0
	CHLORIDE	12	12	0	12	12	0	24	24	0	22	22	0
	COLOUR	12	5	7	12	2	10	24	4	20	22	3	18

TABLE 4

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON

SUMMARY TABLE OF RESULTS (1988)

SCAN	PARAMETER	SITE RAW TOTAL	RAW POSITIVE	RAW TRACE	TREATED TOTAL	TREATED POSITIVE	TREATED TRACE	SITE 1 TOTAL	SITE 1 POSITIVE	SITE 1 TRACE	SITE 2 TOTAL	SITE 2 POSITIVE	SITE 2 TRACE
CHEMISTRY (LAB)	CONDUCTIVITY	12	12	0	12	12	0	24	24	0	22	22	0
	FLUORIDE	12	12	0	12	12	0	24	24	0	22	22	0
	HARDNESS	12	12	0	12	12	0	24	24	0	22	22	0
	IONCAL	12	6	0	12	6	0	24	12	0	24	10	0
	LANGELIERS INDEX	12	12	0	12	12	0	24	24	0	22	22	0
	MAGNESIUM	12	12	0	12	12	0	24	24	0	22	22	0
	SODIUM	12	12	0	12	12	0	24	24	0	22	22	0
	AMMONIUM TOTAL	12	9	3	12	12	0	24	24	0	22	21	0
	NITRITE	12	7	5	12	1	11	24	8	16	22	16	6
	TOTAL NITRATES	12	12	0	12	12	0	24	24	0	22	22	0
	NITROGEN TOT KJELD	12	12	0	12	12	0	24	24	0	22	22	0
	PH	12	12	0	12	12	0	24	24	0	22	22	0
	PHOSPHORUS FIL REACT	12	5	6	12	4	7	.	.	.	.	.	.
	PHOSPHORUS TOTAL	12	7	5	12	2	7	.	.	.	.	.	.
	SULPHATE	6	6	0	6	6	0	12	12	0	10	10	0
	TURBIDITY	12	12	0	12	11	1	24	20	4	22	16	6
*TOTAL SCAN CHEMISTRY (LAB)		246	201	26	246	188	36	432	368	40	398	340	30
METALS	SILVER	12	1	4	12	1	8	24	2	15	24	2	12
	ALUMINUM	12	12	0	12	12	0	24	24	0	24	24	0
	ARSENIC	12	8	4	12	5	7	24	14	10	24	7	17
	BARIUM	12	12	0	12	12	0	24	24	0	24	24	0
	BORON	12	12	0	12	12	0	24	24	0	24	23	1

TABLE 4

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON

SUMMARY TABLE OF RESULTS (1988)

		SITE											
		RAW			TREATED			SITE 1			SITE 2		
SCAN	PARAMETER	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE
METALS	BERYLLIUM	12	1	6	12	1	6	24	2	7	24	2	10
	CADMIUM	12	1	0	12	1	1	24	2	4	24	2	4
	COBALT	12	1	10	12	1	9	24	2	19	24	2	17
	CHROMIUM	12	5	7	12	8	4	24	10	14	24	5	19
	COPPER	12	12	0	12	12	0	24	24	0	24	24	0
	IRON	12	1	11	12	1	9	24	6	18	24	2	15
	MERCURY	12	4	2	12	5	3	12	4	5	12	1	6
	MANGANESE	12	12	0	12	12	0	24	24	0	24	24	0
	MOLYBDENUM	12	12	0	12	12	0	24	24	0	24	24	0
	NICKEL	12	3	8	12	1	9	24	3	19	24	2	17
	LEAD	12	12	0	12	7	5	24	24	0	24	24	0
	ANTIMONY	12	11	1	12	11	1	24	23	1	24	23	1
	SELENIUM	12	1	9	12	1	11	24	2	21	24	2	19
	STRONTIUM	12	12	0	12	12	0	24	24	0	24	24	0
	TITANIUM	12	12	0	12	12	0	24	23	1	24	24	0
	THALLIUM	12	1	2	12	1	2	24	2	4	24	2	6
	URANIUM	12	12	0	12	12	0	24	24	0	24	24	0
	VANADIUM	12	1	11	12	3	9	24	2	22	24	4	20
	ZINC	12	12	0	12	12	0	24	24	0	24	24	0
*TOTAL SCAN METALS		288	171	75	288	167	84	564	337	160	564	319	164
*TOTAL GROUP INORGANIC & PHYSICAL		576	411	101	595	41[illegible]	120	1094	799	200	1043	738	194
CHLOROAROMATICS	HEXACHLOROBUTADIENE	11	0	0	10	0	0	11	0	0	11	0	0

TABLE 4

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON

SUMMARY TABLE OF RESULTS (1988)

SCAN	PARAMETER	SITE RAW TOTAL	RAW POSITIVE	RAW TRACE	TREATED TOTAL	TREATED POSITIVE	TREATED TRACE	SITE 1 TOTAL	SITE 1 POSITIVE	SITE 1 TRACE	SITE 2 TOTAL	SITE 2 POSITIVE	SITE 2 TRACE
CHLOROAROMATICS	123 TRICHLOROBENZENE	11	0	0	10	0	0	11	0	0	11	0	0
	1234 T-CHLOROBENZENE	11	0	0	10	0	0	11	0	0	11	0	0
	1235 T-CHLOROBENZENE	11	0	0	10	0	0	11	0	0	11	0	0
	124 TRICHLOROBENZENE	11	0	0	10	0	0	11	0	0	11	0	0
	1245 T-CHLOROBENZENE	11	0	0	10	0	0	11	0	0	11	0	0
	135 TRICHLOROBENZENE	11	0	0	10	0	0	11	0	0	11	0	0
	HCB	11	0	0	10	0	0	11	0	0	11	0	0
	HEXACHLOROETHANE	11	0	0	10	0	0	11	0	0	11	0	1
	OCTACHLOROSTYRENE	11	0	0	10	0	0	11	0	0	11	0	0
	PENTACHLOROBENZENE	11	0	0	10	0	0	11	0	0	11	0	0
	236 TRICHLOROTOLUENE	11	0	0	10	0	0	11	0	0	11	0	0
	245 TRICHLOROTOLUENE	11	0	0	10	0	0	11	0	0	11	0	0
	26A TRICHLOROTOLUENE	11	0	0	10	0	0	11	0	0	11	0	0
*TOTAL SCAN CHLOROAROMATICS		154	0	0	140	0	0	154	0	0	154	0	1
CHLOROPHENOLS	234 TRICHLOROPHENOL	1	0	0	1	0	0	.	.	.	.	.	.
	2345 T-CHLOROPHENOL	1	0	0	1	0	0	.	.	.	.	.	.
	2356 T-CHLOROPHENOL	1	0	0	1	0	0	.	.	.	.	.	.
	245-TRICHLOROPHENOL	1	0	0	1	0	0	.	.	.	.	.	.
	246-TRICHLOROPHENOL	1	0	0	1	0	0	.	.	.	.	.	.
	PENTACHLOROPHENOL	1	0	0	1	0	0	.	.	.	.	.	.
*TOTAL SCAN CHLOROPHENOLS		6	0	0	6	0	0	0	0	0	0	0	0

TABLE 4

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON

SUMMARY TABLE OF RESULTS (1988)

		SITE											
		RAW			TREATED			SITE 1			SITE 2		
SCAN	PARAMETER	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE
PAH	PHENANTHRENE	12	0	0	12	0	0	.	.	.	.	.	.
	ANTHRACENE	12	0	0	12	0	0	.	.	.	.	.	.
	FLUORANTHENE	12	0	0	12	0	0	.	.	.	.	.	.
	PYRENE	12	0	0	12	0	0	.	.	.	.	.	.
	BENZO(A)ANTHRACENE	12	0	0	12	0	0	.	.	.	.	.	.
	CHRYSENE	12	0	0	12	0	0	.	.	.	.	.	.
	DIMETH. BENZ(A)ANTHR	12	0	0	12	0	0	.	.	.	.	.	.
	BENZO(E) PYRENE	12	0	1	12	0	0	.	.	.	.	.	.
	BENZO(J) FLUORANTHEN	0	0	0	0	0	0	.	.	.	.	.	.
	BENZO(B) FLUORANTHEN	12	0	0	12	0	0	.	.	.	.	.	.
	PERYLENE	12	0	0	12	0	0	.	.	.	.	.	.
	BENZO(K) FLUORANTHEN	12	0	0	12	0	0	.	.	.	.	.	.
	BENZO(A) PYRENE	12	0	0	12	0	0	.	.	.	.	.	.
	BENZO(G,H,I) PERYLEN	12	0	0	12	0	0	.	.	.	.	.	.
	DIBENZO(A,H) ANTHRAC	12	0	0	12	0	0	.	.	.	.	.	.
	INDENO(1,2,3-C,D) PY	12	0	0	12	0	0	.	.	.	.	.	.
	BENZO(B) CHRYSENE	12	0	0	12	0	0	.	.	.	.	.	.
	ANTHANTHRENE	0	0	0	0	0	0	.	.	.	.	.	.
	CORONENE	12	0	0	12	0	0	.	.	.	.	.	.
*TOTAL SCAN PAH		204	0	1	204	0	0	0	0	0	0	0	0
PESTICIDES & PCB	ALDRIN	11	0	0	10	0	0	11	0	0	11	0	0
	ALPHA BHC	11	0	8	10	0	8	11	0	9	11	0	8

TABLE 4

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON

SUMMARY TABLE OF RESULTS (1988)

SCAN	PARAMETER	SITE RAW TOTAL	RAW POSITIVE	RAW TRACE	TREATED TOTAL	TREATED POSITIVE	TREATED TRACE	SITE 1 TOTAL	SITE 1 POSITIVE	SITE 1 TRACE	SITE 2 TOTAL	SITE 2 POSITIVE	SITE 2 TRACE
PESTICIDES & PCB	BETA BHC	11	0	0	10	0	0	11	0	0	11	0	0
	LINDANE	11	0	3	10	0	3	11	0	5	11	0	4
	ALPHA CHLORDANE	11	0	0	10	0	0	11	0	0	11	0	0
	GAMMA CHLORDANE	11	0	0	10	0	0	11	0	0	11	0	0
	DIELDRIN	11	0	0	10	0	0	11	0	0	11	0	0
	METHOXYCHLOR	11	0	0	10	0	0	11	0	0	11	0	0
	ENDOSULFAN 1	11	0	0	10	0	0	11	0	0	11	0	0
	ENDOSULFAN II	11	0	0	10	0	0	11	0	0	11	0	0
	ENDRIN	11	0	0	10	0	0	11	0	0	11	0	0
	ENDOSULFAN SULPHATE	11	0	0	10	0	0	11	0	0	11	0	0
	HEPTACHLOR EPOXIDE	11	0	0	10	0	0	11	0	0	11	0	0
	HEPTACHLOR	11	0	0	10	0	0	11	0	0	11	0	0
	MIREX	11	0	0	10	0	0	11	0	0	11	0	0
	OXYCHLORDANE	11	0	0	10	0	0	11	0	0	11	0	0
	OPDDT	11	0	0	10	0	0	11	0	0	11	0	0
	PCB	11	0	0	10	0	0	11	0	0	11	0	0
	DDD	11	0	0	10	0	0	11	0	0	11	0	0
	PPDDE	11	0	0	10	0	0	11	0	0	11	0	0
	PPDDT	11	0	0	10	0	0	11	0	0	11	0	0
	AMETRINE	12	0	0	12	0	0	12	0	0	12	0	0
	ATRAZINE	12	0	2	12	0	1	12	0	0	12	0	0
	ATRATONE	12	0	0	12	0	0	12	0	0	12	0	0
	CYANAZINE	12	0	0	12	0	0	12	0	0	12	0	0
	DES ETHYL ATRAZINE	6	0	0	6	0	0	6	0	0	6	0	0
	DES ETHYL SIMAZINE	6	0	0	6	0	0	6	0	0	6	0	0

TABLE 4

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON

SUMMARY TABLE OF RESULTS (1988)

		SITE											
		RAW			TREATED			SITE 1			SITE 2		
SCAN	PARAMETER	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE
PESTICIDES & PCB	PROMETONE	12	0	0	12	0	0	12	0	0	12	0	0
	PROPAZINE	12	0	0	12	0	0	12	0	0	12	0	0
	PROMETRYNE	12	0	0	12	0	0	12	0	0	12	0	0
	METRIBUZIN	12	0	0	12	0	0	12	0	0	12	0	0
	SIMAZINE	12	0	0	12	0	0	12	0	0	12	0	0
	ALACHLOR	12	0	0	12	0	0	12	0	0	12	0	0
	METOLACHLOR	12	0	0	12	0	0	12	0	0	12	0	0
*TOTAL SCAN PESTICIDES & PCB		375	0	13	354	0	12	375	0	14	375	0	12
PHENOLICS	PHENOLICS	12	6	4	12	3	7	.	.	.	.	.	.
*TOTAL SCAN PHENOLICS		12	6	4	12	3	7	0	0	0	0	0	0
SPECIFIC PESTICIDES	TOXAPHENE	0	0	0	0	0	0	0	0	0	0	0	0
	2,4,5-T	1	0	0	1	0	0	.	.	.	.	.	.
	2,4-D	1	0	0	1	0	0	.	.	.	.	.	.
	2,4-DB	1	0	0	1	0	0	.	.	.	.	.	.
	2,4 O PROPIONIC ACID	1	0	0	1	0	0	.	.	.	.	.	.
	DICAMBA	1	0	0	1	0	0	.	.	.	.	.	.
	PICHLORAM	0	0	0	0	0	0	.	.	.	.	.	.
	SILVEX	1	0	0	1	0	0	.	.	.	.	.	.
	DIAZINON	1	0	0	1	0	0	.	.	.	.	.	.

TABLE 4

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON

SUMMARY TABLE OF RESULTS (1988)

SCAN	PARAMETER	SITE RAW TOTAL	RAW POSITIVE	RAW TRACE	TREATED TOTAL	TREATED POSITIVE	TREATED TRACE	SITE 1 TOTAL	SITE 1 POSITIVE	SITE 1 TRACE	SITE 2 TOTAL	SITE 2 POSITIVE	SITE 2 TRACE
SPECIFIC PESTICIDES	DICHLOROVOS	1	0	0	1	0	0	.	.	.	.	.	.
	CHLORPYRIFOS	1	0	0	1	0	0	.	.	.	.	.	.
	ETHION	1	0	0	1	0	0	.	.	.	.	.	.
	AZINPHOS-METHYL	0	0	0	0	0	0	.	.	.	.	.	.
	MALATHION	1	0	0	1	0	0	.	.	.	.	.	.
	MEVINPHOS	1	0	0	1	0	0	.	.	.	.	.	.
	METHYL PARATHION	1	0	0	1	0	0	.	.	.	.	.	.
	METHYLTRITHION	1	0	0	1	0	0	.	.	.	.	.	.
	PARATHION	1	0	0	1	0	0	.	.	.	.	.	.
	PHORATE	1	0	0	1	0	0	.	.	.	.	.	.
	RELDAN	1	0	0	1	0	0	.	.	.	.	.	.
	RONNEL	1	0	0	1	0	0	.	.	.	.	.	.
	AMINOCARB	0	0	0	0	0	0	.	.	.	.	.	.
	BENOMYL	1	0	0	1	0	0	.	.	.	.	.	.
	BUX	1	0	0	1	0	0	.	.	.	.	.	.
	CARBOFURAN	1	0	0	1	0	0	.	.	.	.	.	.
	CICP	1	0	0	1	0	0	.	.	.	.	.	.
	DIALLATE	1	0	0	1	0	0	.	.	.	.	.	.
	EPTAM	1	0	0	1	0	0	.	.	.	.	.	.
	IPC	1	0	0	1	0	0	.	.	.	.	.	.
	PROPOXUR	1	0	0	1	0	0	.	.	.	.	.	.
	CARBARYL	1	0	0	1	0	0	.	.	.	.	.	.
	BUTYLATE	1	0	0	1	0	0	.	.	.	.	.	.
*TOTAL SCAN SPECIFIC PESTICIDES		28	0	0	28	0	0	0	0	0	0	0	0

TABLE 4

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON

SUMMARY TABLE OF RESULTS (1988)

SCAN	PARAMETER	SITE RAW TOTAL	RAW POSITIVE	RAW TRACE	TREATED TOTAL	TREATED POSITIVE	TREATED TRACE	SITE 1 TOTAL	SITE 1 POSITIVE	SITE 1 TRACE	SITE 2 TOTAL	SITE 2 POSITIVE	SITE 2 TRACE
VOLATILES	BENZENE	10	0	0	10	0	0	9	0	0	10	0	0
	TOLUENE	10	1	0	10	0	2	9	0	4	10	1	3
	ETHYLBENZENE	10	0	1	10	0	5	9	0	7	10	0	6
	P-XYLENE	9	0	0	10	0	0	9	0	0	10	0	0
	M-XYLENE	10	0	1	10	0	0	9	0	2	10	0	0
	O-XYLENE	9	0	1	10	0	1	9	0	0	10	0	0
	STYRENE	4	0	0	4	0	3	4	0	4	4	0	4
	1,1 DICHLOROETHYLENE	10	0	0	10	0	0	9	0	0	10	0	0
	METHYLENE CHLORIDE	10	0	0	10	0	0	9	0	0	10	0	0
	T1,2DICHLOROETHYLENE	10	0	0	10	0	1	9	0	0	10	0	0
	1,1 DICHLOROETHANE	10	0	0	10	0	0	9	0	0	10	0	0
	CHLOROFORM	9	0	1	9	9	0	8	8	0	9	9	0
	111, TRICHLOROETHANE	10	0	0	10	0	0	9	0	0	10	0	0
	1,2 DICHLOROETHANE	10	0	0	10	0	0	9	0	0	10	0	0
	CARBON TETRACHLORIDE	10	0	0	10	0	0	9	0	0	10	0	0
	1,2 DICHLOROPROPANE	10	0	0	10	0	0	9	0	0	10	0	0
	TRICHLOROETHYLENE	10	0	0	10	0	0	9	0	0	10	0	0
	DICHLOROBROMOMETHANE	10	0	0	9	9	0	8	8	0	9	9	0
	112 TRICHLOROETHANE	10	0	0	10	0	0	9	0	0	10	0	0
	CHLORODIBROMOMETHANE	10	0	0	9	8	0	8	8	0	9	8	1
	T-CHLOROETHYLENE	10	0	0	10	1	0	9	0	0	10	0	0
	BROMOFORM	10	0	0	9	0	9	8	0	8	9	0	7
	1122 T-CHLOROETHANE	10	0	0	10	0	0	9	0	0	10	0	0
	CHLOROBENZENE	10	0	0	10	0	0	9	0	0	10	0	0
	1,4 DICHLOROBENZENE	10	0	0	10	0	0	9	0	0	10	0	0

TABLE 4

DRINKING WATER SURVEILLANCE PROGRAM HAMILTON

SUMMARY TABLE OF RESULTS (1988)

		SITE											
		RAW			TREATED			SITE 1			SITE 2		
SCAN	PARAMETER	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE	TOTAL	POSITIVE	TRACE
VOLATILES	1,3 DICHLOROBENZENE	10	0	0	10	0	0	9	0	0	10	0	0
	1,2 DICHLOROBENZENE	10	0	0	10	0	0	9	0	0	10	0	0
	TRIFLUOROCHLOROTOLUE	3	0	0	3	0	0	2	0	0	3	0	0
	ETHLYENE DIBROMIDE	10	0	0	10	0	0	9	0	0	10	0	0
	TOTL TRIHALOMETHANES	10	0	0	9	9	0	8	8	0	9	9	0
*TOTAL SCAN VOLATILES		284	1	4	282	36	21	253	32	25	282	36	21
*TOTAL GROUP ORGANIC		1063	7	22	1026	39	40	782	32	39	811	36	34
TOTAL		1683	456	123	1665	464	160	1920	839	239	1898	784	228

KEY TO TABLE 5 and 6

A ONTARIO DRINKING WATER OBJECTIVES (ODWO)

1. Maximum Acceptable Concentration (MAC)

1+. MAC for Total Trihalomethanes

1*. MAC for Bacteriological Analyses
Poor water quality is indicated when :
- total coliform counts > 0 < 5
- P/A Bottle Test is present after 48 hours
- Aeromonas organisms are detected in more than 25% of samples in a single submission or in successive submissions from the same sampling site
- Pseudomonas Aeruginosa, Staphylococcus Aureus and members of the Fecal Streptococcus group should not be detected in any sample
- Standard Plate Count should not exceed 500 organisms per ml at 35 ^{0}C within 48 hours

2. Interim Maximum Acceptable Concentration (IMAC)
3. Maximum Desirable Concentration (MDC)
4. Aesthetic or Recommended Operational Guideline
   - hardness levels between 80 and 100 mg/L as calcium carbonate are considered to provide an acceptable balance between corrosion and incrustation, water supplies with a hardness >200 mg/L are considered poor and those in excess of 500 mg/L are unacceptable.

B HEALTH & WELFARE CANADA (H&W)

1. Maximum Acceptable Concentration (MAC)
2. Proposed MAC
3. Interim MAC
4. Aesthetic Objective (AO) (for xylenes, the AO is a total)

C WORLD HEALTH ORGANIZATION (WHO)

1. Guideline Value (GV)
2. Tentative GV
3. Aesthetic GV

D US ENVIRONMENTAL PROTECTION AGENCY (EPA)

1. Maximum Contaminant Level (MCL)
2. Suggested No-Adverse Effect Level (SNAEL)
3. Lifetime Health Advisory
4. EPA Ambient Water Quality Criteria

F EUROPEAN ECONOMIC COMMUNITY (EEC)

1. Health Related Guideline Level
2. Aesthetic Guideline Level
3. Maximum Admissable Concentration (MADC)

G CALIFORNIA STATE DEPARTMENT OF HEALTH-GUIDELINE VALUE

H USSR MAXIMUM PERMISSIBLE CONCENTRATION

I NEW YORK STATE AMBIENT WATER GUIDELINE

N/A NONE AVAILABLE